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FOREIGN TECHNOLOGY DIVISION

THE THIRD GENERATION OF SOVIET CIVILIAN-USE TURBOFAN ENGINES

by

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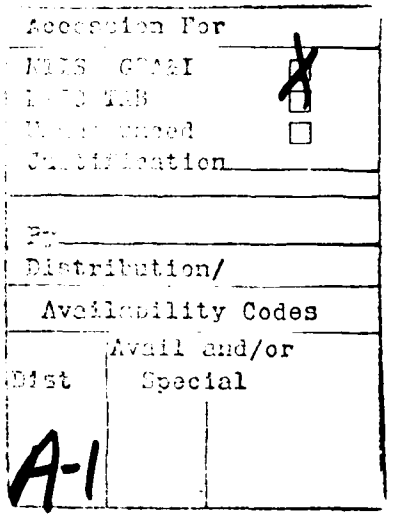

engine is installed a wind turbine starter, with a starting time of 55 seconds.

Currently, relatively little synthetic material is used for this engine, but in the future, carbon fiber fan vanes and other components and assemblies made of synthetic material will be used.

The D-36 is a high bypass ratio turbofan engine that the Soviet Union began to develop in the beginning of the seventies. The main characteristics of this engine are that it has a life as long as 18,000 hours; this was achieved by the use of new technology and new materials, as well as by the installation of additional safety structures and a warning installation. The noise of the engine is low, which was realized by the improvement of the design of the inner and outer cover and the addition of noise insulating material, by increasing the axial gap between the fan rotor vanes and the stator vanes, as well as by a well thought-out accommodation of the numbers of rotor vanes and stator vanes. In addition, the quantity of pollutants exhausted from this engine is small, and is able to meet the pertinent standards of international civilian aeronautics organizations. Figure 3 shows the external appearance of the engine. The table below [not included in translated materials] lists the main technological data for the D-18T and the D-36 engines.

Fig. 3. Exterior of D-36 engine.

The D-18T is used in the An-124 long distance transport plane. This plane was displayed for the first time at the Paris Air Fair in 1985. This was at the time the largest transport plane in the world (surpassed now by the Soviet An-225).

HUMAN TRANSLATION

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THE THIRD GENERATION OF SOVIET CIVILIAN-USE TURBOFAN ENGINES

Xiao Ming

At the beginning of the 1960's, the Soviet Union began to develop turbofan engines for civilian use. To date they have developed three generations.

The first generation (1960-1970):
- D-20P (used on Tu-124),
- D-30 (used on Tu-134), and
- NK-8-2U (used on Tu-154);

The second generation (1970-1980):
- D-30KU (used in Il-62M and Tu-154M), and
- NK-86 (used in Il-86);

The third generation (1980-1990):
- D-36 (used in Yake-42),
- D-18T (used in An-124),
- D-90A (used in Tu-204 and Il-96-300),

All third generation turbofans are high bypass ratio turbofans, and are representative of the current technological level of Soviet civilian turbofan engines.

The D-18T and the D-36. Development on the D-18T was begun at the end of the seventies by the Luotaliefu Engine Design Bureau; the prototype was bench tested in 1981, and a test flight was made in 1983. At the end of 1985, batch production began. This is the Soviet Union's first large thrust high bypass ratio turbofan engine. The design principles of this engine are that it should have a low fuel consumption rate when cruising, that it should be light, that it should have a long life, and that it should offer good performance. To meet these objectives, the D-18T uses three rotor structure

and a design in which the core and the outer cover of the fan are separated by exhaust air. In order to reduce technological risks and to demonstrate empirically feasibility of the whole design and all components, the Design Bureau first developed a version of the D-18T that was smaller in scale, the D-36.

The main components of the D-18T are: 1) A single-level fan (see Fig. 1) with 33 broad chord titanium alloy vanes; at a location of 2/3 of their height, there is an protruding anti-vibration platform. The diameter of the fan is 2,330 mm, and the wheel hub ratio is 0.30. The rotor rotational speed is 3,300 rpm. 2) A seven-level low pressure compressor with adjustable intake nozzle guide vanes. The inlet diameter is 900 mm, and the length is 66 mm. The rotor rotation rate is 5,750 rpm. 3) A seven-level high pressure compressor (see Fig. 2). The vanes of the forward ranks are manufactured from titanium alloy, and those of the rear ranks are made of steel. The rotational rate of the rotor is 9,000 rpm. 4) A circular combustion chamber with 16 atomization nozzles. 5) A one-level high pressure turbine using directional crystal cooled blades. 6) A four-level low pressure turbine transmission fan. On the outer ring of the turbine there is a 0.5 to 0.8 mm thick plasma metal-sprayed layer to guarantee the seal of rotor vanes and the motor box. On the

Fig. 1. D-18T fan.

Fig. 2. The D-18T's high pressure compressor.